TECHNISCHE UNIVERSITÄT
ILMENAU

50. Internationales Wissenschaftliches Kolloquium

September, 19-23, 2005

Maschinenbau von Makro bis Nano / Mechanical Engineering from Macro to Nano

Proceedings

Fakultät für Maschinenbau /
Faculty of Mechanical Engineering

Impressum

Herausgeber:	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
Redaktion:	Referat Marketing und Studentische Angelegenheiten Andrea Schneider Fakultät für Maschinenbau Univ.-Prof. Dr.-Ing. habil. Peter Kurtz, Univ.-Prof. Dipl.-Ing. Dr. med. (habil.) Hartmut Witte, Univ.-Prof. Dr.-Ing. habil. Gerhard Linß, Dr.-Ing. Beate Schlütter, Dipl.-Biol. Danja Voges, Dipl.-Ing. Jörg Mämpel, Dipl.-Ing. Susanne Töpfer, Dipl.-Ing. Silke Stauche
Redaktionsschluss: (CD-Rom-Ausgabe)	31. August 2005
Technische Realisierung: (CD-Rom-Ausgabe)	Institut für Medientechnik an der TU Ilmenau Dipl.-Ing. Christian Weigel Dipl.-Ing. Helge Drumm Dipl.-Ing. Marco Albrecht
Technische Realisierung: (Online-Ausgabe)	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau
Verlag:	isle Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16 98693 Ilmenau

ISBN (Druckausgabe):	3-932633-98-9	(978-3-932633-98-0)
ISBN (CD-Rom-Ausgabe):	3-932633-99-7	(978-3-932633-99-7)

Startseite / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=15745

50. Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
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Jana Kučerová / Ondrej Nemčok

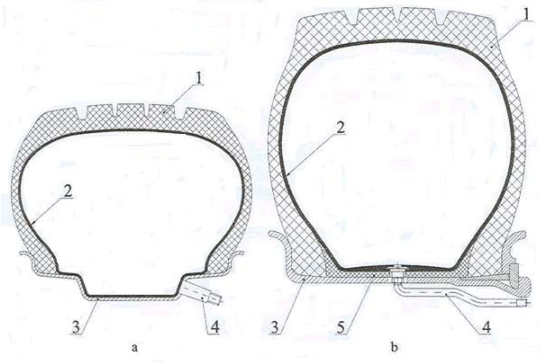
APPLICATION OF EQUIPMENT FOR COMPOSITE TESTING ACCORDING TO STANDARD EU

ABSTRACT

The adhesion has been examined in accord with STN standard, which is considerably different from the ISO standard.
The objective is to design an appliance for adhesion measurement and tests compatible with ISO 814 standard.
The test specimens are composite materials consisted from rubber mixture and brass material. Both of adhesions test results were evaluated by statistical significance.

MATERIALS AND METHODS

Standards STN 62 14 63 and ISO 814 treated of adhesion measurement of rubber and brass. These composite materials are tested by two-plate method. Why test we interface rubber and brass? Because in the tube are contained these materials. In the past were used in passenger tires tube tires, but nowadays there are made only tubeless tires. However in track tires or bicycle tires there are the tubes. Tube is a light, conclave ringlet and it must provide constant pressure in tire.
Tube consists from valve and rubber mixture. Valve is in general brass material and makes possible inflation of tube by pressure medium, regulation of internal pressure, and so on. The description of this system is on the picture.



Tube tire
a – passenger car tire,
b – truck tire
1 – tire, 2 – tube, 3 – rim, 4 – valve,
5 – flap

Fig 1: Tube tires

Standards STN 62 14 63 or ISO 814 practise testing of adhesion rubber and brass. Because Slovakia is member of European Union we must provide rubber testing by international standards.

The test specimens of testing by standard STN and ISO are on the next pictures.

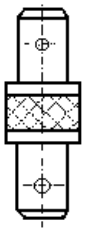


Fig 2: STN test specimen

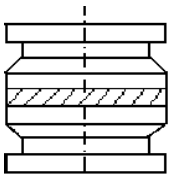


Fig 3: ISO test specimen

Test specimens are composed from rubber disc with thickness of 3 mm, diameters of 25 and 35 mm and its faces must be adhering at two brass plates. Brass elements were made from bar, which is

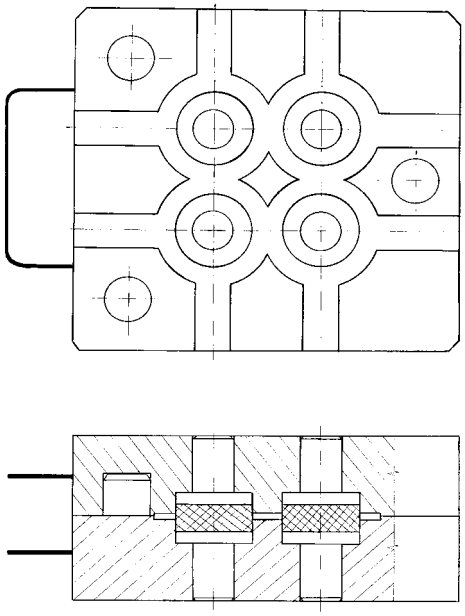


Fig 4: STN cure mould

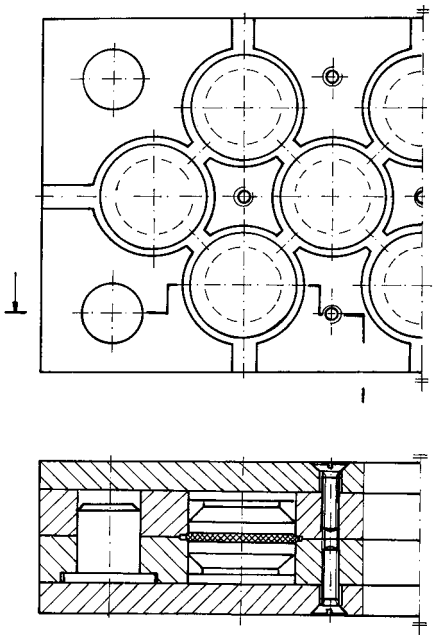


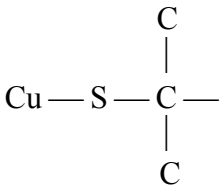
Fig 5: ISO cure mould

marked as CuZn40Pb2 and contains of 40% zinc, 2% of plum bum and other composition is cuprum. Brass elements were grinded and glazed before curing process. The test specimens are prepared in moulds, moulds are located in the curing pressure; illustrations of both moulds are on the pictures.

From these pictures we can see that mould of STN standard produces 4 test specimens, ISO mould can produce 10 test specimens.

During the cure time are running two processes:

- Creation of vulcanizates structure, its increase and creation of cross-links.
- Creation of rubber and brass bond,



by wrong cure conditions / pressure, temperature or time/ are bonds - S – C – breaking and its result to creation of CuS bonds and loss adhesion / see the next picture /. Very important is the fact that the rubber mixtures without sulphur aren't joining with brass. On the other hand the next factors originate of mixing rubber mixtures /e.g. homogenity, mixing of chemical agents and so on/.

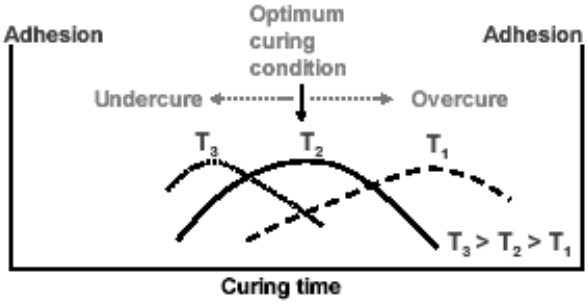


Fig 6: Optimum curing

RESULTS

Rubber blends were modified by rate of vulcanizing agent. Then we tested samples after ageing time 3, 11, 21 and 42 days.

Testing of adhesion according to ISO 814 and STN 62 14 63 standards was realized on Instron 4302 apparatus. On the next table are results of changing rate of adhesion agent so called MANOBOND.

Method / Mixture	**Adhesion STN [MPa]**	**Adhesion ISO [Mpa]**
A0	0,411 ± 0,227	1,36 ± 0,86
A-50	2,833 ± 0,292	3,665 ± 0,448
A-30	4,108 ± 0,44	4,409 ± 0,216
AS	3,709 ± 0,431	4,757 ± 0,23
A+30	5,788 ± 1,45	7,374 ± 0,59
A+50	4,812 ± 1,162	3,224 ± 0,358

Where A0 marked rubber mixture without Manobond, AS is standard rubber mixture, other mixtures marked percent / + addition or - loss / concentration change of adhesion agent.

From presented results follows, that the best adhesion results has mixture A +30 / with 30% addition of vulcanizing agent / for both adhesion test methods. We can see that rubber mixture A +

50 with 50% of Manobond aren't necessary to create.

By notice of adhesion valuation is useful to estimate percent value of breakage surface / rubber on the brass material /. On the next pictures / Fig. 7 and 8 /are presented test specimen after adhesion testing – breakage surface.

Fig. 7

Fig. 8

All measuring values were subjected by method of statistical significance with Yates correction $_{(Y)}\chi_1^2$. This parameter has one degree of freedom and its formula is:

$$_{(Y)}\chi_1^2 = \frac{\left(\left|ad - bc\right| - \frac{N}{2}\right)^2 \cdot N}{(a+b)\cdot(a+c)\cdot(c+d)\cdot(b+d)}, \qquad (2)$$

Where a, b, c, d are multiplicities, which are formulated by yes/ no and N = a + b + c + d. Significance degree is $\alpha = 0{,}05$ and theoretical value of $\chi_1^2{}_{1;\,0{,}05} = 3{,}841$.

Of everything measuring values we can say that ISO 814 standard is the most plausibility than STN 62 14 63 standard and at the same time it verifies request of EU.

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